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Carlson et al.

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(54) **DYNAMIC ENCRYPTION OF A UNIVERSAL RESOURCE LOCATOR**

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H04L 29/08	(2006.01)

(52) **U.S. Cl.**

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(58) **Field of Classification Search**

CPC H04L 67/146
USPC 713/162
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,169,805	B1	1/2001	Dunn et al.
6,484,263	B1	11/2002	Liu
6,970,849	B1	11/2005	DeMello et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0945062	9/1999

OTHER PUBLICATIONS

Berners-Lee, Masinter and McCahill; Request for Comments: 1738; Uniform Resource Locators (URL); Retrieved from Internet on Nov. 1, 2009, http://www.w3.org/Addressing/rfc1738.txt, 22 pages.

(Continued)

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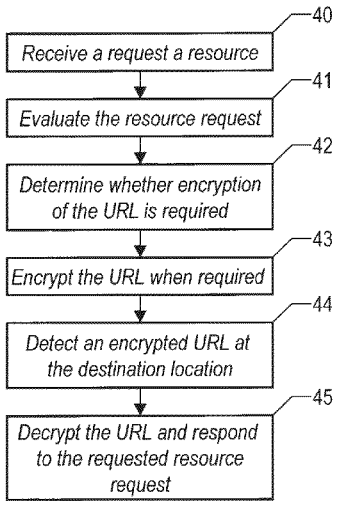
(57) **ABSTRACT**

A system including a computer and a computer readable hardware storage device containing instructions which, upon being executed by the computer, implements a method for restricting access to information transmitted over a computing network. A resource request for a resource to be located is received. The resource request contains a universal resource locator (URL). The URL is evaluated to determine whether encryption of none, part, or all of the URL is required. It is determined that the requested resource is available and in response, the requested resource contained in the resource request is located. It is determined whether encryption is required for none, part, or all of a return URL of the requested resource that is to be returned to a location of the resource request.

8 Claims, 8 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

7,043,752	B2	5/2006	Royer et al.
7,089,425	B2	8/2006	Chan
8,819,419	B2	8/2014	Carlson et al.
2002/0032782	A1	3/2002	Rangan et al.
2002/0094870	A1	7/2002	Murray
2003/0037070	A1	2/2003	Marston
2003/0037232	A1	2/2003	Bailiff
2003/0163740	A1	8/2003	Thjai et al.

OTHER PUBLICATIONS

Notice of Allowance (Mail date Apr. 3, 2014) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

RCE (filed Oct. 8, 2013) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Notice of Allowance (Mail date Jan. 9, 2014) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Response to Post-examiner's answer (filed Jul. 27, 2009) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Post-examiner's answer (mail date Mar. 24, 2009) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Examiner's answer (mail date Nov. 7, 2008) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Appeal Brief (filed Aug. 20, 2008) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Notice of Appeal (filed Aug. 20, 2008) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Appeal Brief (filed Nov. 17, 2007) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Notice of Appeal (filed Oct. 15, 2007) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Petition to Revive (filed Feb. 27, 2008) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Advisory Action (mail date Jul. 6, 2007) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Final Response (filed Jun. 25, 2007) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Final Office Action (mail date Mar. 26, 2007) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Response (filed Jan. 12, 2007) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

Office Action (mail date Sep. 12, 2006) for U.S. Appl. No. 10/406,664, filed Apr. 3, 2003, Conf. No. 1831.

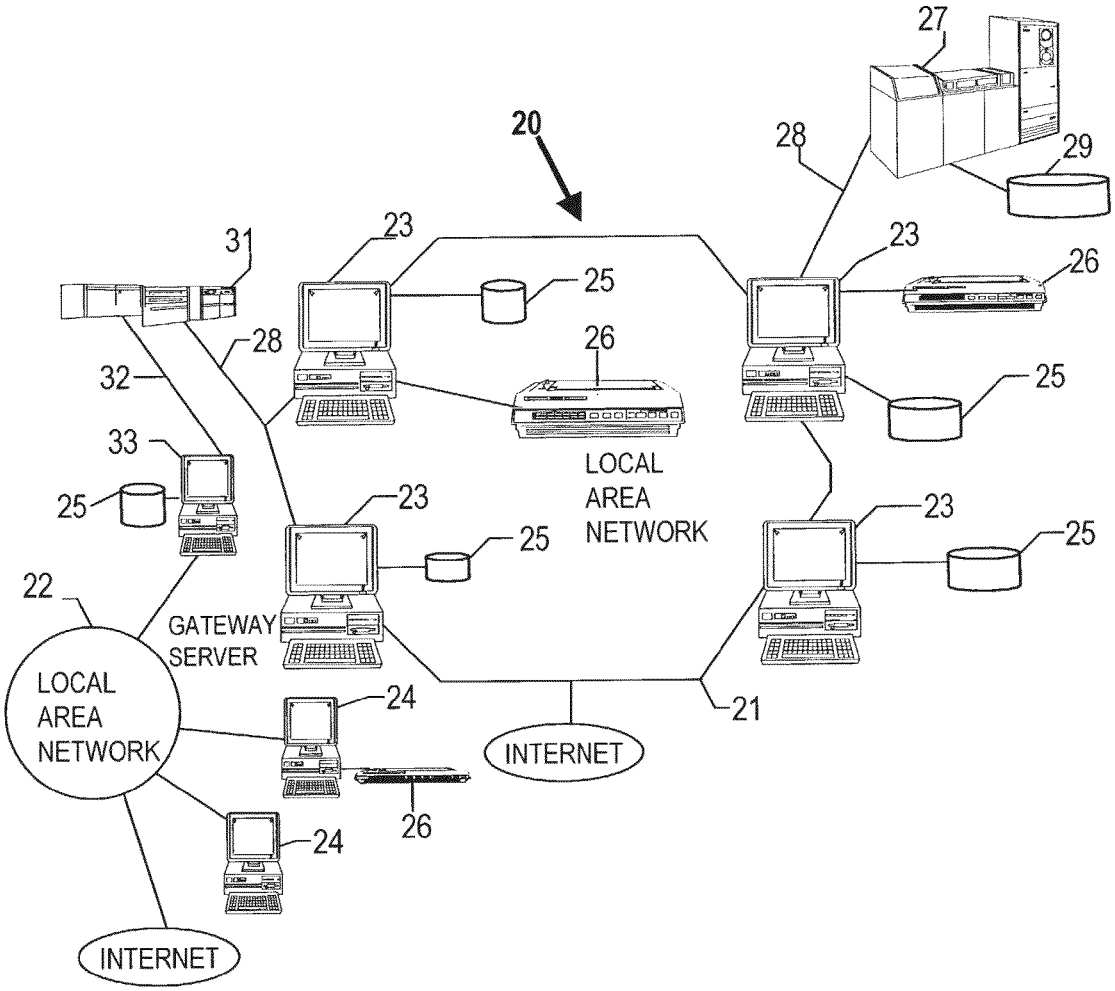

20
27
28
29
31
23
25
26
32
33
LOCAL
AREA
NETWORK
22
GATEWAY
SERVER
LOCAL
AREA
NETWORK
24
21
INTERNET
INTERNET

FIG. 1

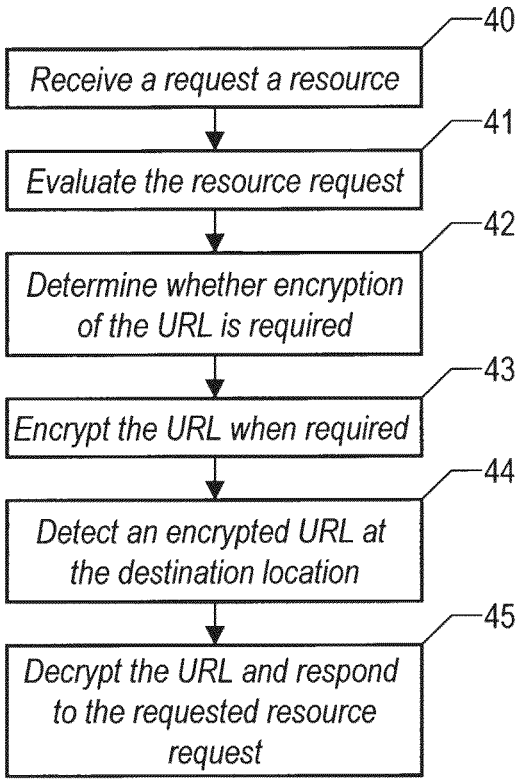

40
Receive a request a resource
41
Evaluate the resource request
42
Determine whether encryption of the URL is required
43
Encrypt the URL when required
44
Detect an encrypted URL at the destination location
45
Decrypt the URL and respond to the requested resource request

FIG. 2

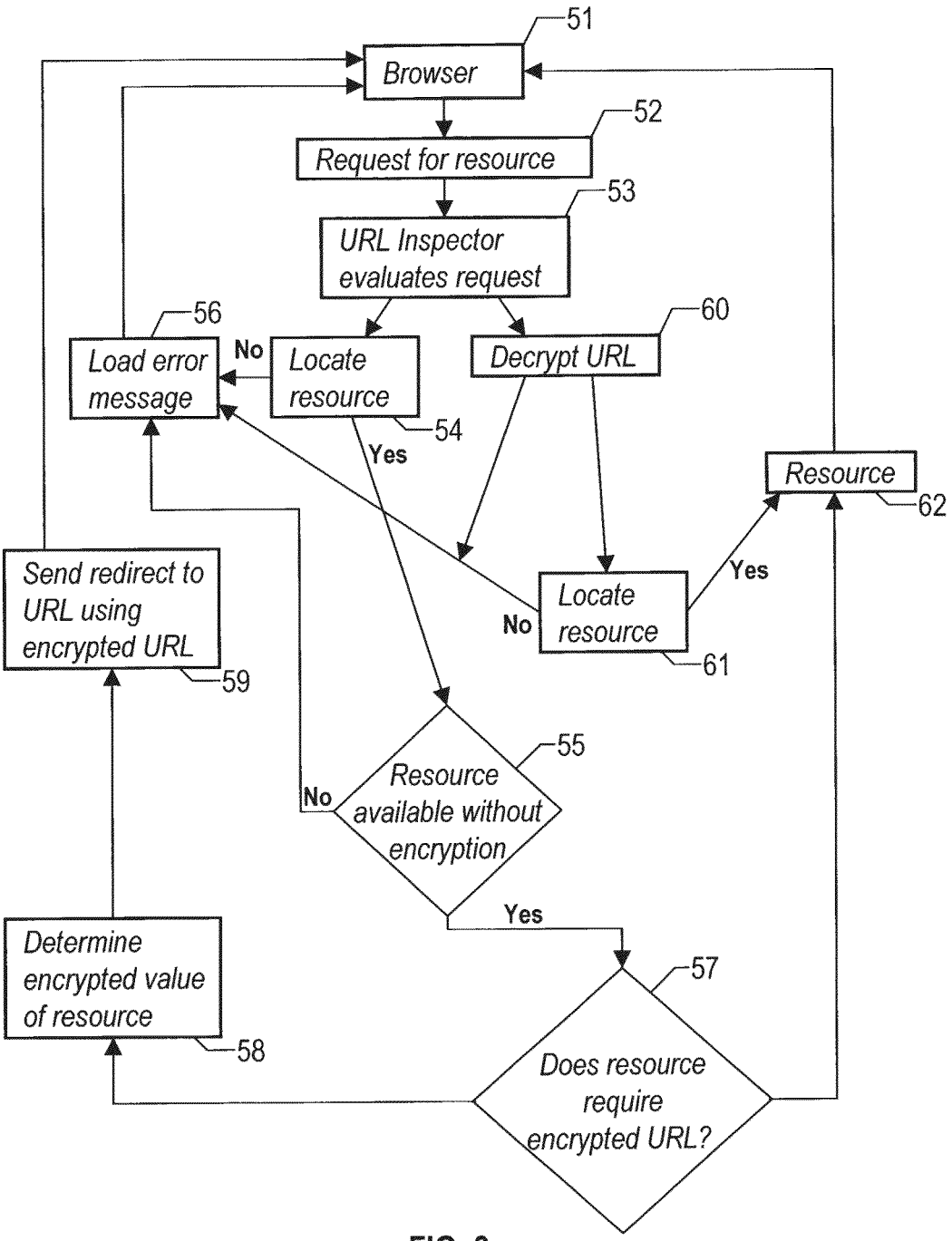

51
Browser
52
Request for resource
53
URL Inspector evaluates request
56
Load error message
No
Locate resource
54
Yes
Decrypt URL
60
Resource
62
Send redirect to URL using encrypted URL
59
Locate resource
61
No
Yes
55
Resource available without encryption
No
Yes
Determine encrypted value of resource
58
57
Does resource require encrypted URL?

FIG. 3

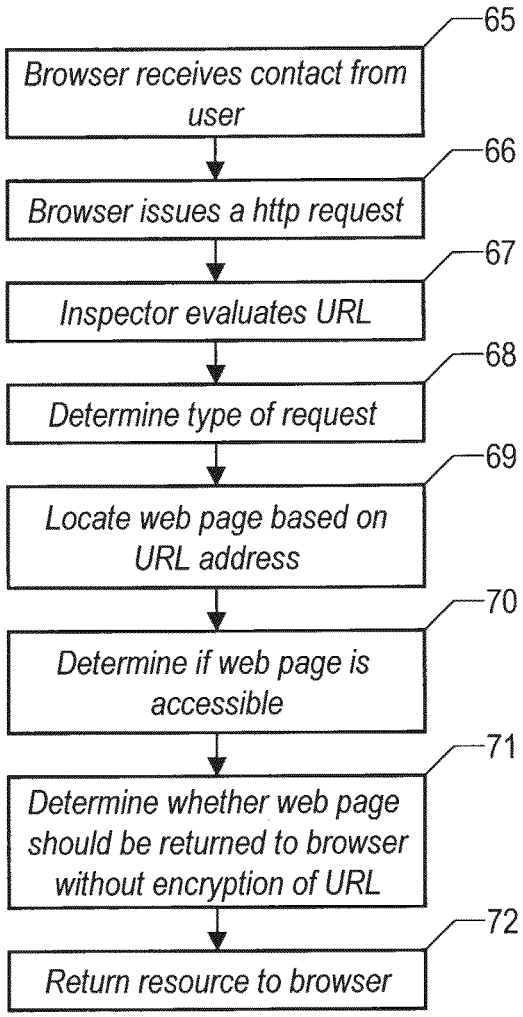

65
Browser receives contact from user
66
Browser issues a http request
67
Inspector evaluates URL
68
Determine type of request
69
Locate web page based on URL address
70
Determine if web page is accessible
71
Determine whether web page should be returned to browser without encryption of URL
72
Return resource to browser

FIG. 4

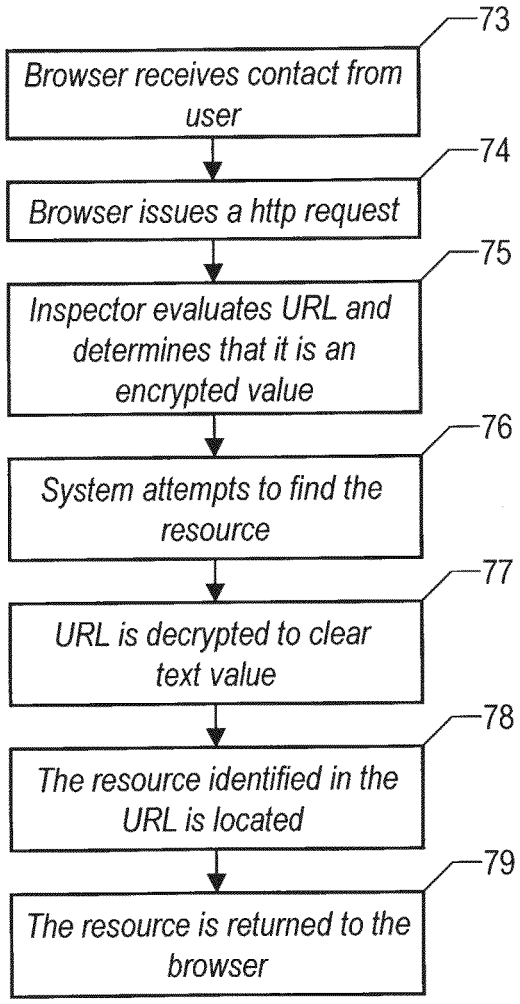

73
Browser receives contact from user
74
Browser issues a http request
75
Inspector evaluates URL and determines that it is an encrypted value
76
System attempts to find the resource
77
URL is decrypted to clear text value
78
The resource identified in the URL is located
79
The resource is returned to the browser

FIG. 5

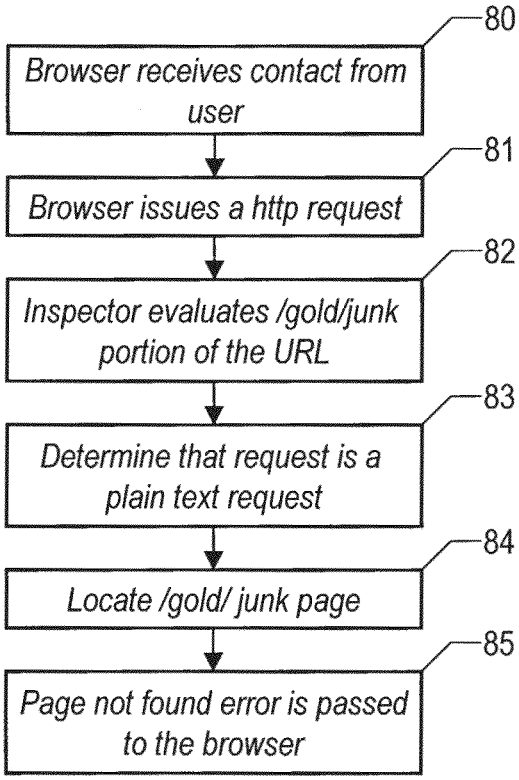

80
Browser receives contact from user
81
Browser issues a http request
82
Inspector evaluates /gold/junk portion of the URL
83
Determine that request is a plain text request
84
Locate /gold/ junk page
85
Page not found error is passed to the browser

FIG. 6

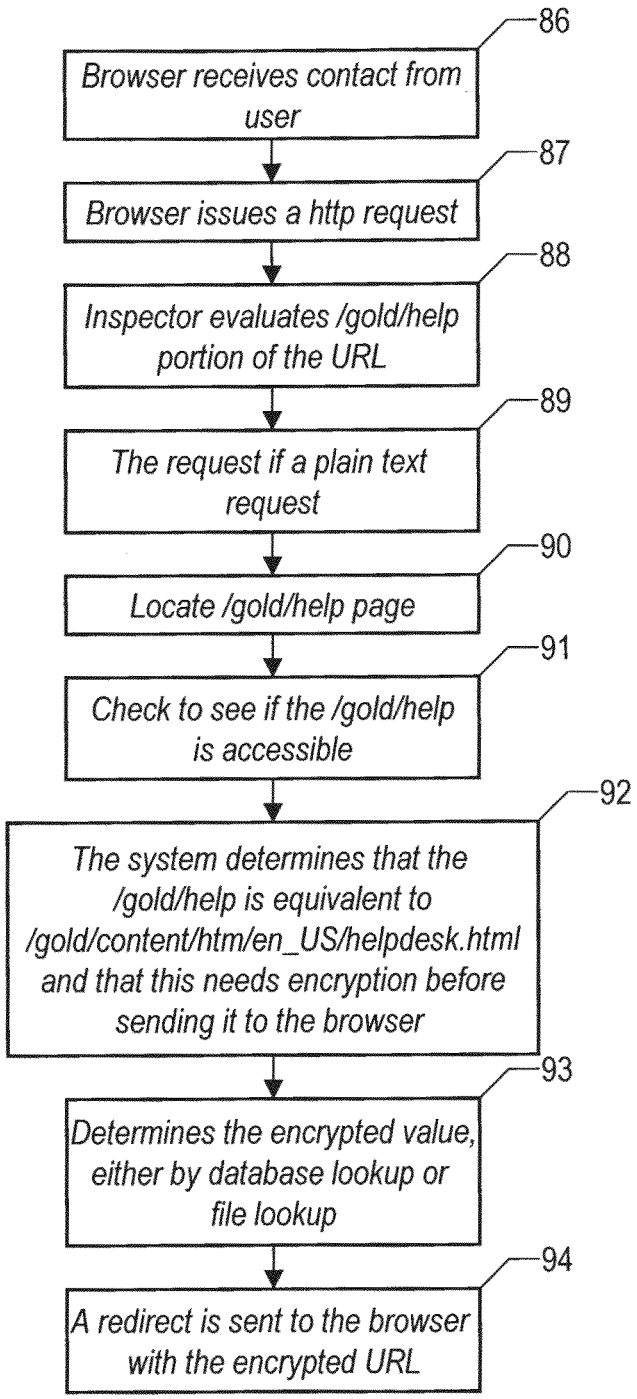

86
Browser receives contact from user
87
Browser issues a http request
88
Inspector evaluates /gold/help portion of the URL
89
The request if a plain text request
90
Locate /gold/help page
91
Check to see if the /gold/help is accessible
92
The system determines that the /gold/help is equivalent to /gold/content/htm/en_US/helpdesk.html and that this needs encryption before sending it to the browser
93
Determines the encrypted value, either by database lookup or file lookup
94
A redirect is sent to the browser with the encrypted URL

FIG. 7

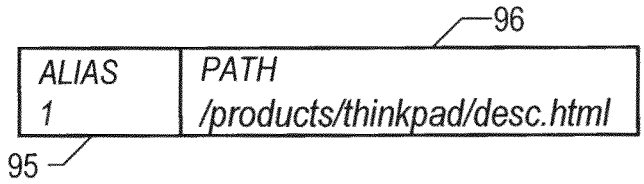


FIG. 8

DYNAMIC ENCRYPTION OF A UNIVERSAL RESOURCE LOCATOR

This application is a continuation application claiming priority to Ser. No. 10/406,664, filed Apr. 3, 2003, now U.S. Pat. No. 8,819,419 issued Aug. 26, 2014.

FIELD OF THE INVENTION

The present invention provides a method and system for protecting computing devices, systems and networks from unauthorized access gained through the contents of messages transmitted across a computing network and in particular to a method and system for protecting computing systems from unauthorized access, gained through the contents of URLs, by dynamic encryption of URLs which are part of messages transmitted across a computing network.

BACKGROUND OF THE INVENTION

The Internet, which started in the late 1960s, is a vast computer network consisting of many smaller networks that span the entire globe. The Internet has grown exponentially, and millions of worldwide users ranging from individuals to corporations now use permanent and dial-up connections to access the Internet on a daily basis. The computers or networks of computers connected within the Internet, known as "hosts", allow public access to databases containing information in nearly every field of expertise and are supported by entities ranging from universities and government to many commercial organizations.

The information on the Internet is made available to the public through "servers". A server is a system running on an Internet host for making available files or documents contained within that host. Such files are typically stored on magnetic storage devices, such as tape drives or fixed disks, local to the host. An Internet server may distribute information to any computer that requests the files on a host. The computer making such a request is known as the "client", which may be an Internet-connected workstation, bulletin board system or home personal computer (PC).

The World-Wide Web (Web) is a method of accessing information on the Internet which allows a user to navigate the Internet resources intuitively, without IP addresses or other technical knowledge. The Web dispenses with command-line utilities which typically require a user to transmit sets of commands to communicate with an Internet server. Instead, the Web is made up of hundreds of thousands of interconnected "pages", or documents, which can be displayed on a computer monitor. The Web pages are provided by hosts running special servers. Software which runs these Web servers is relatively simple and is available on a wide range of computer platforms including PC's. Equally available is a form of client software, known as a Web "browser", which is used to display Web pages as well as traditional non-Web files on the client system. Today, the Internet hosts which provide Web servers are increasing at a rate of more than 300 per month.

Each Web page may contain pictures and sounds in addition to text. Hidden behind certain text, pictures or sounds are connections, known as "hypertext links" ("links"), to other pages within the same server or even on other computers within the Internet. For example, links may be visually displayed as words or phrases that may be underlined or displayed in a second color. Each link is directed to a web page by using a special name called a URL (Uniform Resource Locator). URLs enable a Web browser to go directly to any

file held on any Web server. A user may also specify a known URL by writing it directly into the command line on a Web page to jump to another Web page.

A document designed to be accessed and read over the web is called a web page. Each web page must have an address in a recognized format—the URL, or Uniform Resource Locator—that enables computers all over the world to access it. Each web page has an unique URL. A web page typically contains both text and images. Because image files are large, even when compressed, it could take a long time to retrieve a web page, especially when a voice-quality phone line is used to connect to the Internet. Consequently, it is important to design a browser which is able to reduce the amount of time to display a web page.

As previously mentioned, a URL is a Uniform Resource Locator, a standard way developed to specify the location of a resource available electronically. URLs make it possible to direct both people and software applications to a variety of information, available from a number of different Internet protocols. Most commonly, a user will encounter URLs when using a World Wide Web (WWW) client, as that medium uses URLs to link WWW pages together. In a WWW browser's "location" box, the item that generally starts with "http:" is a URL. Files available over protocols besides HTTP, such as FTP and Gopher can be referenced by URLs. Even Telnet sessions to remote hosts on the Internet and someone's Internet e-mail address can be referred to by a URL.

A URL is like similar to a person's complete mailing address: it specifies all the information necessary for someone to address an envelope to you. However, they are much more than that, since URLs can refer to a variety of very different types of resources. A more fitting analogy would be a system for specifying a user's mailing address, the user's telephone number, or the location of a book a user has just read from the public library. All of this information would be in one format. URLs have a very specific syntax and all s follow the format.

The URL naming system consists of three parts: the transfer format, the host name of the machine that holds the file, and the path to the file. An example of a URL may be: "http://" concatenated with "www.college.univ.edu/Adir/Bdir/Cdir/page.html", where "http" represents the transfer protocol; a colon and two forward slashes (://) are used to separate the transfer format from the host name; "www.college.univ.edu" is the host name in which "www" denotes that the file being requested is a Web page;"/Adir/Bdir/Cdir" is a set of directory names in a tree structure, or a path, on the host machine; and "page.html" is the file name with an indication that the file written in HTML. In short, a URL is a very convenient and succinct way to direct people and applications to a file or other electronic resource.

The Internet maintains an open structure in which exchanges of information are made cost-free without restriction. The free access format inherent to the Internet, however, presents difficulties for those information providers requiring control over their Internet servers. Consider for example, a research organization that may want to make certain technical information available on its Internet server to a large group of colleagues around the globe, but the information must be kept confidential. Without means for identifying each client, the organization would not be able to provide information on the network on a confidential or preferential basis. In another situation, a company may want to provide highly specific service tips over its Internet server only to customers having service contracts or accounts.

Access control by an Internet server is difficult for at least two reasons. First, when a client sends a request for a file on

a remote Internet server, that message is routed or relayed by a web of computers connected through the Internet until it reaches its destination host. The client does not necessarily know how its message reaches the server. At the same time, the server makes responses without ever knowing exactly who the client is or what its IP address is. While the server may be programmed to trace its clients, the task of tracing is often difficult, if not impossible. Secondly, to prevent unwanted intrusion into private local area networks (LAN), system administrators implement various data-flow control mechanisms, such as the Internet "firewalls", within their networks. An Internet firewall allows a user to reach the Internet anonymously while preventing intruders of the outside world from accessing the user's LAN.

For various historical and technical reasons, internet URLs are designed in such a way that the directory structure of your web server is exposed to the outside world. This exposure allows hackers an inside look at your system. In many cases on a public web server you do not want this type of information exposed as it opens the door to possible intrusion.

It's considerably harder to configure servers to permit users to access appropriate resources without exposing the web-server to possible intrusions. Using an alias system can become very cumbersome and difficult to manage. Alternatively, trying to obscure information by creating a complicated layout of the files system can add to the problems of system management and content updates.

There are known weaknesses with many operating systems that allow shell meta-characters (*, & etc.,) to break the application, thereby exposing the web-server. It may sound far-fetched but it happens most of the times. Some of the conventional methods for transferring information via a computing network are defined as:

Get Method:

Normally a URL string is used to pass information (parameters) from page to page. On the receiving end, the URL string is parsed and appropriate actions are taken. One way to pass the parameters is by method=get, with this method, the parameters are displayed in the URL e.g., "http://"concatenated with "www.ibm.com/gold/ParseForm?username=abc&password=abc123".

Post Method:

Kind of hides. You can prevent sensitive information from being displayed in the URL by using method=instead of method=get. But to be precise Post does not hide information in the URL, it sends the information in the HTTP headers apart from the URL. It's still possible to intercept the headers.

SSL:

In the case of Post method, the Post data is hidden from external users, but the action portion of the form is still visible. In the users browser, the POST data is available by viewing the source of the web page. In the case of the GET method, nothing is hidden but the contents of the web resources, i.e. the URL remains visible to all. While post and SSL hide information passed from page to page, they actually do-not encrypt the URL exposing the structure of the web-server.

Redirecting:

Another possible solution would be to redirect to the requested resource. Again, while this could be useful, it would still allow users to view the URL.

Aliasing:

Aliasing URL's to point to different directories can be useful in obscuring some amount of information about your web server, but aliasing only works to a point. Sub-directories would still be visible at lower levels and directory structures would still be exposed to external users. Aliasing also requires a large amount of manual configuration work. It is not easily reconfigured and additions are also time consuming and not dynamic.

Although these methods can adequately transmit information via a computing network, none these methods can adequately protect unauthorized access to messages involved in the transmission. In addition, even though network security schemes exist that can protect access to the contents of messages; it is believed that no current system attempts to protect access to the Universal Resource Locators (URLs) that are part of each message transmission. Access to the URLs can enable unauthorized persons to learn important information about the directory structures of resources on a network. This information could enable one to cause substantial harm to resources connected to the network and ultimately to the entire network. Therefore, there remains a need for a solution that provides a dynamic, easily configurable system, which can be used to encrypt or otherwise hide the internal structure of your web server. URLs can be changed without changes to the web server or to the file system of the web server.

SUMMARY OF THE INVENTION

It is an objective of the present invention to provide a method and system to protect access to a Universal Resource Locator (URL) during the transmission of information over a communication network.

It is a second objective of the present invention to provide a method and system for encrypting part or all of a URL during the transmission of information over a communication network.

It is a third objective of the present invention to provide a method and system to decrypt the encrypted portions of a URL after the transmitted information is received at a destination location.

It is a fourth objective of the present invention to determining whether to encrypt a particular URL prior to transmission of information over the communication network.

The present invention provides a dynamic, easily configurable system, which can be used to encrypt or otherwise hide the internal structure of a network device such as a web server. URLs can be changed without changes to the web server or to the file system of the web server. The present invention protects access to computing systems via a URL by encrypting all or a portion of the URL during the transmission of information over a network. Prior to the actual transmission of the information, fields in the URL can be encrypted using conventional encryption techniques. The encryption will occur after the destination has been determined such that the encryption will not cause the information to be misdirected to a wrong destination. At the destination location, there is first a determination that this URL is encrypted. At this point, a decryption technique is employed based on the encryption scheme to decrypt the URL. The full URL is now accessed only by the destination location and is not accessible during travel over the network between the originating and destination locations.

There are several advantages of using this invention. 1) The encryption of the URL hides the directory structure of the web-server; 2) The techniques of the present invention address the Cross Site Scripting security issue ("http://" concatenated with "www.cert.org/advisories/CA-2000-02.html"); and 3) The present invention allows dynamic URL modifications.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of a computer network over which messages may be transmitted between a user and the reservation center of the present invention.

FIG. **2** is a flow diagram of the general concept and implementation for encrypting a Universal Resource Locator (URL) in accordance with the present invention.

FIG. **3** is a detailed block and flow diagram illustrating the concept and implementation of the present invention.

FIG. **4** is a flow diagram of the implement of the present invention when encryption of the URL is not necessary.

FIG. **5** is a flow diagram of the implement of the present invention when it is necessary to decrypt a URL if the requested URL is encrypted.

FIG. **6** is a flow diagram of the implement of the present invention when an error condition occurs.

FIG. **7** is a flow diagram of the implement of the present invention in a second situation in which encryption of the URL is necessary.

FIG. **8** is an example of a database record for an encryption format using database lookup method of encryption and decryption.

DETAILED DESCRIPTION OF THE INVENTION

The method of the present invention may be implemented in a global computer network environment such as the Internet. The system used to access and communicate via the computer network could be conventional computer terminal system comprised of a computer, and peripheral devices including a monitor, keyboard and mouse. With reference now FIG. **1**, there is depicted a pictorial representation of a distributed computer network environment **20** in which one may implement the method and system of the present invention. As may be seen, distributed data processing system **20** may include a plurality of networks, such as Local Area Networks (LAN) **21** and **22**, each of which preferably includes a plurality of individual computers **23** and **24**, respectively. Of course, those skilled in the art will appreciate that a plurality of Intelligent Work Stations (IWS) coupled to a host processor may be utilized for each such network. Any of the processing systems may also be connected to the Internet as shown. As is common in such data processing systems, each individual computer may be coupled to a storage device **25** and/or a printer/output device **26**. One or more such storage devices **25** may be utilized, in accordance with the method of the present invention, to store the various data objects or documents which may be periodically accessed and processed by a user within distributed data processing system **20**, in accordance with the method and system of the present invention. In a manner well known in the prior art, each such data processing procedure or document may be stored within a storage device **25** which is associated with a Resource Manager or Library Service, which is responsible for maintaining and updating all resource objects associated therewith.

Still referring to FIG. **1** it may be seen that distributed data processing system **20** may also include multiple mainframe computers, such as mainframe computer **27**, which may be preferably coupled to Local Area Network (LAN) **21** by means of communications link **28**. Mainframe computer **27** may also be coupled to a storage device **29** which may serve as remote storage for Local Area Network (LAN) **21**. A second Local Area Network (LAN) **22** may be coupled to Local Area Network (LAN) **21** via communications controller **31** and communications link **32** to a gateway server **33**. Gateway server **33** is preferably an individual computer or Intelligent Work Station (IWS) which serves to link Local Area Network (LAN) **22** to Local Area Network (LAN) **21**. As discussed above with respect to Local Area Network (LAN) **22** and Local Area Network (LAN) **21**, a plurality of data processing procedures or documents may be stored within storage device **29** and controlled by mainframe computer **27**, as Resource Manager or Library Service for the data processing procedures and documents thus stored. Of course, those skilled in the art will appreciate that mainframe computer **27** may be located a great geographical distance from Local Area Network (LAN) **21** and similarly Local Area Network (LAN) **21** may be located a substantial distance from Local Area Network (LAN) **24**. That is, Local Area Network (LAN) **24** may be located in California while Local Area Network (LAN) **21** may be located within Texas and mainframe computer **27** may be located in New York.

FIG. **2** is a flow diagram of the general concept and implementation of the present invention. In step **40**, a resource request is received from a user at a computer location. This request usually goes from the originating location to a web browser. At this point, step **41** evaluates the URL of the originating request to determine the location of the requested resource and any contents of the message. Based on information, which could include the location of the requested resource and the contents of the originating request message, step **42** determines whether the URL of the original resource request requires encryption prior to transmission of the request. The encryption analysis occurs after the determination of the destination location of the message so as to not misdirect the message during transmission. If the URL requires encryption, step **43** encrypts the URL. The encryption scheme can be a conventional scheme. The encryption of the URL could be a partial encryption or a total encryption. Once the message reaches the desired destination, step **44** detects that the URL is in an encrypted form and initiates a decryption technique based on the original encryption scheme in step **45**. In the reply message to the original resource request, the same type of URL encryption occurs.

FIG. **3** is a detailed block and flow diagram illustrating the concept and implementation of the present invention. In block **51**, a user is viewing a page in a web browser containing one for more internet hyperlinks. When the user selects one of these links, the browser issues a request for the specified resource. At this point, in block **52**, the user's browser issues an http (or ftp, gopher) style request using the GET or POST method. For purposes of this discussion the GET method will be used to issue the http. This request is sent across the network to an internet server. Block **53** incorporates a URL inspection technique on the server that evaluates the URI portion of the URL (i.e. the portion of the URL after the {schema}://{host}:{port} portion). In the evaluation, the URL inspector determines whether the request URL is a standard, plaint text URL or if it is an encrypted URL. If the determination is that the requested URI is plain text, the process moves to block **54**. Otherwise, the process follows goes to step **60**. In block **54**, the step is to determine if the request for the resource, using a plain text using URL, is available on the system. If so, the system attempts to locate the resource in the same block **54**. If the resource is located on the system, the process moves to block **55**. If the resource was not found, the process moves to block **56**. In the case of block **55**, since this resource has been requested using a plain text URL, the system must determine if the resource is available without using an encrypted URL (i.e. just because it is there, it might not be accessible using a plain text URL). If the resource is not available without encryption, the process moves to block **56**. If the resource is available without encryption, there must be a determination whether the resource URL requires encryption before returning the resource to the browser of the original requester. This process occurs in step **57**. If the resource is to be returned without a URL change,

then the process moved to step **62**. The resource is returned to the requesting browser **51**. Otherwise, if the URL must be encrypted, the process moves to step **58**. In block **58**, the encrypted URL value is calculated or determined (via database lookup, file lookup, etc.). Once the value is determined, the process moves to block **59**. The new, encrypted URL is returned to the browser via a redirect procedure. This return of the URL will tell the browser to issue a new request using the new, encrypted URL. This URL return can alternatively be done by returning a page to the browser with a link to the resource using the new URL along with or without a message.

Referring to block **56**, when the process reaches this point, an error has occurred at some point during the process. The error condition exist because the system has determined that the requested URL cannot be returned to the browser because: a) the resource is not available, b) the resource is truly not present (i.e. **404** type of error, from step **54** and step **61**, c) the resource was requested via plain text and this is not allowed (from block **55**) or d) because the encrypted URL could not be decrypted (from block **60**).

Referring back to block **53**, if the value is determined to be other than a plain text request, the process moves to block **60**. At this point, the URL from the requester is decrypted and verified. If there is an error decrypting the URL or the encrypted URL is determined to be invalid, the process moves to step **56**, otherwise the process moves to step **61**. In step **61**, the system attempts to locate the resource. If the resource is not found, the process moves to step **56**. If the resource is located, the process moves to step **62**. In step **62**, the requested resource is returned to the user's browser.

FIG. **4** is a flow diagram of the implementation of the present invention is in the conventional situation when it is not necessary to encrypt the URL. In this implementation, in step **65**, the user's browser receives an access request from the user. This request contains a URL to a particular web location. For purposes of this example the URL is "http://" concatenated with "www.ibm.com/gold/Welcome". The browser in step **66** issues an http request based on this URL in the user's access request. The evaluation of this URL occurs in step **67**. In this evaluation, there is an inspection of the "/gold/Welcome" portion of URL. This portion of the URL is the specific location in the directory. The inspection of the URL resulted in a determined that the request was a plain text request, step **68**. After a determination that the request was a plain text request, step **69** locates the '/gold/Welcome' page. Once the page is located, step **70** determines whether the page is accessible. If the page is accessible, there is a determination whether this page should be returned to browser in an encrypted form, step **71**. This determination can be based on the security policy established for that system. In this example, the determination is that the page should be returned without encryption. Step **72** returns this page to the browser as requested by the user.

FIG. **5** illustrates the situation when it is necessary to decrypt a URL if the requested URL is encrypted. The URL in this example is: "http://" concatenated with "www.ibm.com/gold/ParseForm/xxx/xxx/xxx/xxx". The 'xxx/xxx/xxx/xxx' represents the encrypted portion of the URL. For the implementation of the present invention in this case, the browser receives a contact from the user in step **73**. The URL contained in the user request will not have encrypted information. In step **74**, the browser will issue an http request. This request will contain an encrypted URL. For the URL the encryption procedure occurs before the browser issues the http request. The encryption could be a matching procedure wherein each URL received at the browser is matched in a database table to a corresponding encrypted URL. The particular encryption scheme can change periodically for security reasons. As mentioned earlier, the encryption scheme can also incorporate the entire URL or only a portion of the URL. Specific encryption schemes will be examined later in this discussion.

Referring to step **75**, the evaluation of the encrypted 'xxx/xxx/xxx/xxx' portion of the URL occurs. In this particular URL, the determination is that the URL has an encrypted value. As a result of this determination, step **76** attempts to find the resource. This attempt can be based on the known or unencrypted part of the URL or on some scheme based on the initial unencrypted URL entered by the user. At the destination server of the URL, step **77** performs a decryption procedure of the encrypted URL and determines a clear-text value, '/gold/ParseForm/username/abc/useremail/abc@123'. After the decryption procedure, step **78** locates the resource '/gold/ParseForm/* portion of the URL for desired resource. As shown, the encrypted portion of the URL is indicated by the *. However, internally, after the decryption, the location of the actual address is known at the server. In step **79**, the requested resource is returned to the browser and requesting user.

FIG. **6** is an illustration of an error condition in the implementation of the steps in the present invention. In this example the URL is "http://" concatenated with "www.ibm.com/gold/junk". In step **80**, the browser receives a contact from a user connected to that browser. The browser issues an http request based on the received URL in step **81**. Prior to submitting this http request, the browser could perform an internal check to determine whether this URL has a corresponding encrypted version. If no corresponding encrypted version exists, the http request goes forward as usual. Step **82** evaluates the '/gold/junk' portion of the URL. The evaluation determines that the request is a plain text request step **83**. Step **84** attempts to locate this '/gold/junk' page. Since there is a mistake in this URL and no such page exist, the attempt to locate this page will fail. As a result, step **85** sends a page not found error back to the browser originating the URL request.

FIG. **7** illustrates a condition using the help page URL "http://" concatenated with "www.ibm.com/gold/help". Basically, this is a setup in a way that depending on the browser locale, the corresponding locale help page is displayed. This case is also one wherein the URL in the initial request is not encrypted, however, the URL in the response to the initial request is encrypted. The process begins in a manner similar to the process in step **4**. In this implementation, in step **86**, the user's browser receives an access request from the user. This request contains a URL to a particular web location. For purposes of this example the URL is "http://" concatenated with "www.ibm.com/gold/help". The browser in step **87** issues an http request based on this URL in the user's access request. The evaluation of this URL occurs in step **88**. In this evaluation, there is an inspection of the "/gold/help" portion of URL. This portion of the URL is the specific location in the directory. The inspection of the URL resulted in a determined that the request was a plain text request, step **89**. After a determination that the request was a plain text request, step **90** locates the '/gold/help' page. Once the page is located, step **91** determines whether the page is accessible. If the page is accessible, there is a determination whether this page should be returned to browser in an encrypted form, step **92**. At this point, the determination is that the URL portion '/gold/help' is equivalent to '/gold/content/html/en_US/helpdesk.html. As a result of this determine, this URL needs to be encrypted before sending it to the requesting browser. Step **93** can determine the encrypted values for the URL based on lookup schemes such a database lookup or file lookup scheme. In step **94**, a redirect (define) is then sent to the browser with the encrypted URL.

In the present invention, the actual encryption procedure can be performed using conventional encryption schemes. These schemes can range from basic lookup tables to complex public key/private key encryption schemes. For example, there is the URL "'http://" concatenated with "www.ibm.com/sbc/products/thinkpad/desc.html" and it is desired to encrypt the '/products/thinkpad/desc.html portion of the URL. The simplest way to encrypt this portion would be to increment each character according to the encryption scheme a=b, b=c, etc. As the result of this encryption scheme the resulting encrypted URL would be 30 "http://" concatenated with "www.ibm.com/sbc/qspevdut/uijolqbe/eftd.html". Referring to FIG. **8**, for more complex web-sites, where several html contents are created through some content management tools, the encryption scheme can be a database lookup. As shown in FIG. **8**, the database lookup for the above-illustrated URL has an alias field **95** and a path field **96**. The resulting URL transmitted over the network would be "http://" concatenated with "www.ibm.com/sbc/1". Other matching lookup could follow a similar format and structure.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those skilled in the art will appreciate that the processes of the present invention are capable of being distributed in the form of instructions in a computer readable hardware storage device such as EPROM, ROM, tape, paper, floppy disc, hard disk drive, RAM, and CD-ROMs.

The invention claimed is:

1. A system comprising a computer and a computer readable hardware storage device, said storage device containing instructions which, upon being executed by the computer, implements a method for restricting access to information transmitted over a computing network, said method comprising:

receiving, by the computer at a network location, a resource request for a resource to be located, said resource request containing a universal resource locator (URL);

evaluating, by the computer, the URL to determine whether encryption of none, part, or all of the URL is required;

determining by the computer, that the requested resource is available and in response, locating, by the computer, the requested resource contained in the resource request; and

determining, by the computer, whether encryption is required for none, part, or all of a return URL of the requested resource that is to be returned to a location of the resource request.

2. The system of claim **1**, said method comprising after said determining that the requested resource is available:

determining, by the computer, that encryption of the requested resource is required and in response, determining, by the computer, whether the URL of the requested resource is required; and

determining, by the computer, the encrypted value of the requested resource.

3. The system of claim **2**, said method further comprising:

encrypting, by the computer, the return URL; and

sending, by the computer, the encrypted URL to the location of the resource request.

4. A system comprising a computer and a computer readable hardware storage device, said storage device containing instructions which, upon being executed by the computer, implements a method for restricting access to information transmitted over a computing network, said method comprising:

receiving, by the computer at a network location, a resource request for a resource to be located, said request containing a universal resource locator (URL);

evaluating, by the computer, the URL to determine that encryption of the URL is not required and in response, locating, by the computer, the requested resource;

determining, by the computer, that the requested resource is available;

encrypting, by the computer, the URL contained in the resource request; and

determining, by the computer in response to said determining that the requested resource is available, whether encryption of a return URL of the requested resource is required.

5. The system of claim **4**, said method further comprising after a determination that encryption of the return URL of the requested resource is required:

determining, by the computer, an encrypted value for the return URL; and

sending, by the computer, a redirect to a browser originating the resource request using the encrypted value for the return URL.

6. The system of claim **4**, said method further comprising:

sending, by the computer, the resource to a browser originating the resource request in response to a determination that encryption of the return URL is not required.

7. A system comprising a computer and a computer readable hardware storage device,

said storage device containing instructions which, upon being executed by the computer, implements a method for restricting access to information transmitted over a computing network, said method comprising:

receiving, by the computer, at a network location, a resource request for a resource to be located, said resource request containing a universal resource locator (URL);

evaluating, by the computer, the URL to determine that encryption of the URL is required and in response, encrypting, by the computer, the URL of the network location;

transmitting, by the computer, a message containing the encrypted URL to a destination of the requested resource;

receiving, by the computer, the message at the destination;

identifying, by the computer, the requested resource based on the information in the encrypted URL;

decrypting, by the computer, the encrypted URL;

determining, by the computer, whether the requested resource is available; and

locating, by the computer, the requested resource.

8. The system of claim **7**, said method further comprising after said locating the requested resource:

determining, by the computer, whether encryption of a return URL of the requested resource is required in response to a determination that the requested resource is available.

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